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HOSPITAL ADMISSION RATES AND LENGTHS OF TREATMENT AMONG A CONUS-BASED COHORT OF NAVY PERSONNEL

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Among a CONUS-based Cohort of Navy Personnel**

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Introduction

With the advent of advanced, 'smart' technologies, smaller-sized complements of personnel will be responsible for accomplishing the same tasks that much larger forces handled in the past. As a consequence, smaller numbers of personnel who become medically ineffective have the potential for a much greater impact on the accomplishment of operational missions. Thus, it is critical to determine threshold levels of disease and injury rates so that the appropriate degrees of training and cross-training with various advanced technologies may be determined.

Objective

The objective of this effort was to determine the number of individuals who may be unavailable on the eve of a hypothetical deployment due to disease and nonbattle injury (DNBI) hospital admissions.

Methods

A cohort of Navy personnel enlisting after the Gulf War (April 1991- December 1992) was defined using service history files maintained by the Naval Health Research Center in San Diego, CA. The length of each service member's time in the Navy was then determined from the service history files. Records of hospital admissions for this cohort were then extracted from medical history files maintained at the Naval Health Research Center. Rates of DNBI incidence and mean lengths of treatment were computed for the overall cohort, and for men and women service members separately.

Results

The overall rate of hospitalization for the Navy cohort examined was 0.304 admissions per 1000 strength per day. The mean length of treatment was 5.32 days. Multiplying the admission rate times the mean length of treatment yields a 'medically ineffective' rate of 1.62 individuals per 1000 strength per day. A substantial gender difference in hospitalization incidence did exist, due largely to female admissions for pregnancy-related conditions.

Conclusions

Determination of the levels of training and cross-training of personnel on advanced technologies critical to mission success should take into consideration that two people per 1000 strength may be medically ineffective on any given day.

Hospital Admission Rates and Lengths of Treatment Among a CONUS-based Cohort of Navy Personnel

Introduction

With the advent of advanced, 'smart' technologies, smaller-sized complements of personnel will be responsible for accomplishing the same tasks that much larger forces handled in the past. As a consequence, smaller numbers of personnel who become medically ineffective have the potential for a much greater impact on the accomplishment of operational missions. It is thus critical to determine threshold levels of disease rates so that the appropriate levels of training and cross-training with various technologies may be determined. By determining the number of individuals who may be unavailable on the eve of a hypothetical deployment due to disease and nonbattle injury (DNBI) hospital admissions, planners may more accurately determine the overall number of personnel needed to ensure operational success.

The Defense Advanced Research Projects Agency (DARPA) requested that the Naval Health Research Center conduct a small-scale study to determine the likely level of medical ineffectiveness on the eve of a potential operational deployment. Because of the controversy surrounding the health of some veterans returning from combat service, the decision was taken to limit the study population to those Navy personnel who enlisted after the Southwest Asia combat deployment. Further, because the Navy has discontinued the formal recording of inpatient admissions aboard ships, the study was limited to those personnel attached to U.S. shore stations and those assigned to vessels that did not make prolonged deployments.

Method

All Navy personnel enlisting in the service for the first time between April 1991 and December 1992 were included within the study cohort. The time period examined was from the point of service entry until December 31, 1997, unless the service member exited the service before this cut-off date. This cut-off date was chosen because there is often a lag between a hospitalization and the time that that specific admission is entered into the inpatient data files; selection of this particular date ensured that all hospitalizations occurring up through 1998 would have been entered at the time the extract was created.

The total person-days for each service member were computed as the time period from service entry until one of three criteria were met: 1) exit from service if before 12/31/1997, 2) the cut-off date was achieved, or 3) the service member was assigned to a non-CONUS shore facility or to a ship that makes other than brief deployments. This third criteria was necessary because personnel subject to sustained sea duty cannot be tracked medically during these deployments since inpatient records are no longer maintained for personnel on deployed ships; similarly, while personnel treated at Naval overseas medical facilities have those hospital admissions recorded, any admissions while en route would not be recorded. Total person-days were summed across the entire cohort to determine overall 'days at risk.'

After the days-at-risk were computed, hospital admissions during each individual's period-at-risk were tabulated. Admissions were tabulated by International Classification of Disease (ICD) categories: Infectious & Parasitic Disorders; Neoplasms; Endocrine, Nutritional, & Metabolic Diseases and Immunity Disorders; Diseases of the Blood and Blood-forming Organs; Mental Disorders; Nervous System and Sense Organ Disorders; Circulatory Disorders; Respiratory Disorders; Digestive Disorders; Genitourinary Disorders; Pregnancy-related Conditions; Skin & Subcutaneous Tissue Disorders; Musculoskeletal System and Connective Tissue disorders; Congenital Anomalies; Symptoms, Signs, and Ill-Defined Conditions; Injuries and Poisonings; and Supplemental Conditions. Hospital admission rates were computed by dividing the total hospital admissions, and individual ICD category totals, into the overall days at risk. To avoid exceedingly small numbers, rates were computed per 1000 strength per day. Hospital admission rates were also computed for male and female personnel separately.

Mean length of hospital stay was determined by computing the days between admission and discharge for each hospitalization and then averaging across all hospitalizations. Lastly, a 'medically ineffective' rate was computed for the overall population, and males and females separately, by multiplying the hospitalization rates by the mean lengths of stay.

Results

There were 55,789 Navy personnel who enlisted in the time period of this study; these personnel represented 25,074,789 person-days. Within this cohort, there were 47,674 males and 8,115 females; these sub-populations comprised 19,912,862 and 5,161,927 person-days respectively. The mean age within the cohort was 20.69 years.

Table 1 is a display of the numbers and rates of hospitalizations within each ICD category for the total cohort. The overall rate of hospitalization incidence was 0.304 per 1000 strength per day. The most prevalent categories of hospitalization were Pregnancy-related conditions, Mental disorders, and Musculoskeletal System problems. Table 2 is a presentation of the disease category percentage and rates for male and female personnel separately. Mental disorders comprised the largest percentage of the male hospital admissions (28.3%) while pregnancy-related conditions constituted the largest category percentage for females (42.4%). The overall hospitalization rate for males was 0.219, while the rate for females was 0.632.

Often, individuals have more than a single diagnosis for any given hospitalization. Table 3 juxtaposes the category percentages for primary diagnoses with the percentages for secondary diagnoses. As can be seen from Table 3, the Supplementary Conditions category comprised one-fifth of the secondary diagnoses. The most prevalent diagnoses within this category were: V27 (Outcome of delivery; 51% of Supplementary diagnoses) and V57 (Care involving use of rehabilitation procedures; 13% of Supplementary diagnoses)

Table 4 is a display of the 15 most prevalent diagnoses for hospital admissions among the entire cohort, while Tables 5 and 6 separately present the most prevalent diagnoses for males and females. Among males, adjustment reactions, alcohol dependence syndrome, and personality disorders were the most prevalent reasons for hospitalization. Among females, pregnancy-related conditions and adjustment reactions were the most frequent diagnoses underlying hospital admissions.

Table 7 is a presentation of the average length of hospital stay by ICD category of admission. The average length of stay across disease categories was 5.32 days. The longest mean length of stay was for the mental disorders category (13.9 days) while the shortest average stay was for the category of musculoskeletal disorders (1.96 days). Table 8 is a display of the cohort's category illness rates, mean lengths of stay, and 'medically ineffective' rates derived by multiplying the illness rates times the average lengths of hospital stay. As can be seen from Table 8, the data indicated that 1.62 person-days per 1000 were lost to hospitalization. Tables 9 and 10 present the 'medically ineffective' rates for males and females separately.

Summary

Any determinations as to the appropriate levels of training and cross-training needed to ensure that sufficient personnel are available to operate 'smart' technologies must factor in the numbers of personnel that may be medically unavailable at any point in time. An examination of hospitalization incidence among a cohort of Navy personnel enlisting in the year following the Gulf War indicated an overall hospitalization rate of 0.304 per 1000 strength per day and an average length of hospitalization of 5.32 days. Combined, these two statistics indicate that 1.62 of every 1000 person-days are lost to hospitalization. The medical ineffective rate for males was 1.42 per 1000 person-days while the rate for females was 2.40.

Because this study examined a cohort of recent enlistees to avoid any potential confounding with Gulf War service, the mean age of the cohort (20.7 yrs) is younger than the general Navy population. While this study was designed to be small in scope because of budgetary considerations, it nevertheless provides a general idea of the numbers of Naval personnel that may be unavailable at any given time for medical reasons. Should a more comprehensive examination of medical ineffectiveness by occupation and/or across a wider sampling of the Navy population be desirable, the Naval Health Research Center stands ready to assist in such an endeavor.

**Table 1. Distribution and Rates of Hospitalization by International Classification of Disease
Category for U.S. Navy Cohort**

International Classification of Disease (ICD) Category	Number of Hospitalizations	Percent of Hospitalizations	Hospital Rate per 1000 strength per day
Infectious/Parasitic	355	4.7%	0.0142
Neoplasm	138	1.8%	0.0055
Endocrine	70	0.9%	0.0028
Diseases of the Blood	40	0.5%	0.0016
Mental Disorders	1630	21.4%	0.0650
Nervous System	173	2.3%	0.0069
Circulatory	73	1.0%	0.0029
Respiratory	505	6.6%	0.0201
Digestive	651	8.5%	0.0260
Genitourinary	406	5.3%	0.0162
Preg., Childbirth, Puerperium	1383	18.1%	0.0552
Skin/Subcutaneous	252	3.3%	0.0100
Musculoskeletal	727	9.5%	0.0290
Congenital	64	0.8%	0.0026
Symptoms/ill-defined conditions	276	3.6%	0.0110
Injury, poisoning	683	9.0%	0.0272
Supplementary	202	2.6%	0.0081
Total	7628	100.0%	0.3042

**Table 2. Hospitalization Rates by Gender and International Classification
of Disease (ICD) Categories for Cohort of U.S. Navy Personnel**

International Classification of Disease (ICD) Category	Males			Females		
	No. of Hosp.	Percent of Hosp.	Hosp. Rate per 1000 strength per day	No. of Hosp.	Percent of Hosp.	Hosp. Rate per 1000 strength per day
Infectious/Parasitic	270	6.2%	0.0136	85	2.6%	0.0165
Neoplasm	66	1.5%	0.0033	72	2.2%	0.0139
Endocrine	31	0.7%	0.0016	39	1.2%	0.0076
Diseases of the Blood	27	0.6%	0.0014	13	0.4%	0.0025
Mental Disorders	1234	28.3%	0.0620	396	12.1%	0.0767
Nervous System	116	2.7%	0.0058	57	1.7%	0.0110
Circulatory	58	1.3%	0.0029	15	0.5%	0.0029
Respiratory	341	7.8%	0.0171	164	5.0%	0.0318
Digestive	471	10.8%	0.0237	180	5.5%	0.0349
Genitourinary	136	3.1%	0.0068	270	8.3%	0.0523
Preg., Childbirth, Puerperium	0	0.0%	-	1383	42.4%	0.2679
Skin/Subcutaneous	216	4.9%	0.0108	36	1.1%	0.0070
Musculoskeletal	509	11.7%	0.0256	218	6.7%	0.0422
Congenital	36	0.8%	0.0018	28	0.9%	0.0054
Symptoms/ill-defined conditions	182	4.2%	0.0091	94	2.9%	0.0182
Injury, poisoning	555	12.7%	0.0279	128	3.9%	0.0248
Supplementary	119	2.7%	0.0060	83	2.5%	0.0161
Total	4367	100.0%	0.2193	3261	100.0%	0.6317

Table 3. Number and Percent of Primary and Secondary Diagnoses by International Classification of Disease (ICD) Categories for U.S. Navy Cohort

International Classification of Disease (ICD) Category	Number of Primary Diagnoses	Percent of Primary Diagnoses		Number of Secondary Diagnoses	Percent of Secondary Diagnoses
Infectious/Parasitic	355	4.7%		318	4.0%
Neoplasm	138	1.8%		90	1.1%
Endocrine	70	0.9%		211	2.6%
Diseases of the Blood	40	0.5%		160	2.0%
Mental Disorders	1630	21.4%		1594	19.9%
Nervous System	173	2.3%		154	1.9%
Circulatory	73	1.0%		101	1.3%
Respiratory	505	6.6%		360	4.5%
Digestive	651	8.5%		312	3.9%
Genitourinary	406	5.3%		318	4.0%
Preg., Childbirth, Puerperium	1383	18.1%		1246	15.5%
Skin/Subcutaneous	252	3.3%		139	1.7%
Musculoskeletal	727	9.5%		402	5.0%
Congenital	64	0.8%		38	0.5%
Symptoms/ill-defined conditions	276	3.6%		287	3.6%
Injury, poisoning	683	9.0%		678	8.5%
Supplementary	202	2.6%		1608	20.1%
Total	7628	100.0%		8016	100.0%

**Table 4. Fifteen Most Prevalent International Classification of Disease (ICD) Diagnoses
Among Hospitalized Members of Navy Cohort**

ICD Code	ICD Description	No. of hospitalizations	Percent of hospitalizations
309	Adjustment reaction	533	6.99%
303	Alcohol dependence syndrome	369	4.84%
301	Personality disorders	320	4.20%
664	Perineum and vulva trauma during delivery	243	3.19%
717	Internal derangement of knee	176	2.31%
52	Chickenpox	176	2.31%
474	Chronic disease of tonsils and adenoids	142	1.86%
682	Other cellulitis and abscess	129	1.69%
656	Other fetal and placental problems	124	1.63%
780	General symptoms	124	1.63%
644	Early or threatened labor	123	1.61%
305	Nondependent abuse of drugs	118	1.55%
550	Inguinal hernia	116	1.52%
718	Other derangement of joint	112	1.47%
727	Other disorders of synovium, tendon and bursa	110	1.44%
Total		2915	38.21%*

*Total number of hospitalizations among Navy cohort = 7,628

**Table 5. Fifteen Most Prevalent International Classification of Disease (ICD) Diagnoses
Among Male Members of Navy Cohort**

ICD Code	ICD Description	No. of hospitalizations	Percent of hospitalizations
309	Adjustment reaction	385	8.82%
303	Alcohol dependence syndrome	303	6.94%
301	Personality disorders	232	5.31%
52	Chickenpox	156	3.57%
717	Internal derangement of knee	140	3.21%
682	Other cellulitis and abscess	117	2.68%
550	Inguinal hernia	110	2.52%
305	Nondependent abuse of drugs	104	2.38%
780	General symptoms	94	2.15%
718	Other derangement of joint	81	1.85%
540	Acute appendicitis	77	1.76%
474	Chronic disease of tonsils and adenoids	70	1.60%
520	Disorders of tooth development and disruption	69	1.58%
296	Affective psychoses	64	1.47%
727	Other disorders of synovium, tendon and bursa	59	1.35%
Total		2061	47.19%*

*Total number of hospitalizations among male personnel = 4,367

**Table 6. Fifteen Most Prevalent International Classification of Disease (ICD) Diagnoses
Among Female Members of Navy Cohort**

ICD Code	ICD Description	No. of hospitalizations	Percent of hospitalizations
664	Perineum and vulva trauma during delivery	243	7.45%
309	Adjustment reaction	148	4.54%
656	Other fetal and placental problems	124	3.80%
644	Early or threatened labor	123	3.77%
650	Normal delivery	108	3.31%
661	Abnormality of forces of labor	106	3.25%
301	Personality disorders	88	2.70%
474	Chronic disease of tonsils and adenoids	72	2.21%
303	Alcohol dependence syndrome	66	2.02%
634	Spontaneous abortion	66	2.02%
642	Hypertension complicating pregnancy, the puerperium	57	1.75%
663	Umbilical cord complications	54	1.66%
648	Conditions complicating pregnancy, the puerperium	52	1.59%
727	Other disorders of synovium, tendon and bursa	51	1.56%
658	Other problems amniotic cavity and membrane	47	1.44%
Total		1405	43.08%*

*Total number of hospitalizations among female personnel = 3,261

**Table 7. Mean Lengths of Hospital Stay and Percent Distribution of Stays
by ICD Disease Categories for U.S. Navy Cohort**

International Classification of Disease (ICD) Category	Average Length of Hosp. Stay	Stay of 0.5 - 3 days	Stay of 4 - 7 days	Stay of 8 - 14 days	Stay of 15 - 30 days	Stay of 31+ days
Infectious/Parasitic	4.68	35.5%	53.0%	10.7%	0.6%	0.3%
Neoplasm	3.49	71.7%	15.9%	7.2%	5.1%	0.0%
Endocrine	3.34	64.3%	27.1%	5.7%	2.9%	0.0%
Diseases of the Blood	4.68	57.5%	32.5%	7.5%	0.0%	2.5%
Mental Disorders	13.89	35.2%	21.6%	12.6%	12.5%	18.2%
Nervous System	4.17	74.0%	14.5%	6.4%	2.9%	2.3%
Circulatory	3.32	76.7%	15.1%	5.5%	1.4%	1.4%
Respiratory	2.48	76.0%	19.8%	3.2%	0.8%	0.2%
Digestive	2.64	79.1%	14.6%	4.9%	1.2%	0.2%
Genitourinary	2.32	77.6%	17.5%	4.2%	0.7%	0.0%
Preg., Childbirth, Puerperium	2.61	83.6%	13.9%	1.7%	0.7%	0.1%
Skin/Subcutaneous	3.30	59.1%	34.9%	5.6%	0.4%	0.0%
Musculoskeletal	1.96	87.3%	8.3%	3.4%	0.6%	0.4%
Congenital	3.59	82.8%	9.4%	6.3%	0.0%	1.6%
Symptoms/ill-defined conditions	3.22	69.9%	22.1%	6.5%	1.1%	0.4%
Injury, poisoning	4.45	67.3%	20.4%	5.9%	4.8%	1.6%
Supplementary	2.39	85.1%	8.9%	4.0%	1.0%	1.0%
Total	5.32	66.6%	19.1%	6.2%	3.8%	4.3%

**Table 8. Medical Ineffective Rates for CONUS-based Cohort
of Navy Personnel by ICD Disease Category**

International Classification of Disease (ICD) Category	Hosp. Rate (daily per 1000 strength)	Avg. Length of Hospital Stay (days)	Ineffective Rate (daily per 1000 strength)
Infectious/Parasitic	0.014	4.68	0.066
Neoplasm	0.006	3.49	0.019
Endocrine	0.003	3.34	0.009
Diseases of the Blood	0.002	4.68	0.007
Mental Disorders	0.065	13.89	0.903
Nervous System	0.007	4.17	0.029
Circulatory	0.003	3.32	0.010
Respiratory	0.020	2.48	0.050
Digestive	0.026	2.64	0.069
Genitourinary	0.016	2.32	0.038
Preg., Childbirth, Puerperium	0.055	2.61	0.144
Skin/Subcutaneous	0.010	3.30	0.033
Musculoskeletal	0.029	1.96	0.057
Congenital	0.003	3.59	0.009
Symptoms/ill-defined conditions	0.011	3.22	0.035
Injury, poisoning	0.027	4.45	0.121
Supplementary	0.008	2.39	0.019
Total	0.304	5.32	1.619

**Table 9. Medical Ineffective Rates for Male CONUS-based
Navy Personnel by ICD Disease Category**

International Classification of Disease (ICD) Category	Hosp. Rate (daily per 1000 strength)	Avg. Length of Hospital Stay (days)	Ineffective Rate (daily per 1000 strength)
Infectious/Parasitic	0.014	4.94	0.067
Neoplasm	0.003	5.43	0.018
Endocrine	0.002	4.73	0.007
Diseases of the Blood	0.001	4.04	0.005
Mental Disorders	0.062	14.44	0.895
Nervous System	0.006	4.64	0.027
Circulatory	0.003	3.02	0.009
Respiratory	0.017	2.78	0.048
Digestive	0.024	2.79	0.066
Genitourinary	0.007	2.72	0.019
Preg., Childbirth, Puerperium	----	----	----
Skin/Subcutaneous	0.011	3.28	0.036
Musculoskeletal	0.026	2.05	0.052
Congenital	0.002	5.35	0.010
Symptoms/ill-defined conditions	0.009	3.67	0.034
Injury, poisoning	0.028	4.20	0.117
Supplementary	0.006	2.54	0.015
Total	0.219	6.50	1.425

**Table 10. Medical Ineffective Rates for Female CONUS-based
Navy Personnel by ICD Disease Category**

International Classification of Disease (ICD) Category	Hosp. Rate (daily per 1000 strength)	Avg. Length of Hospital Stay (days)	Ineffective Rate (daily per 1000 strength)
Infectious/Parasitic	0.016	3.86	0.064
Neoplasm	0.014	1.72	0.024
Endocrine	0.008	2.23	0.017
Diseases of the Blood	0.003	6.00	0.015
Mental Disorders	0.077	12.60	0.967
Nervous System	0.011	3.22	0.036
Circulatory	0.003	4.47	0.013
Respiratory	0.032	1.87	0.059
Digestive	0.035	2.26	0.079
Genitourinary	0.052	2.11	0.111
Preg., Childbirth, Puerperium	0.268	2.61	0.698
Skin/Subcutaneous	0.007	3.42	0.024
Musculoskeletal	0.042	1.76	0.074
Congenital	0.005	1.32	0.007
Symptoms/ill-defined conditions	0.018	2.34	0.043
Injury, poisoning	0.025	5.54	0.137
Supplementary	0.016	2.17	0.035
Total	0.632	3.80	2.400

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14. ABSTRACT (maximum 200 words)

Objective. This effort is to determine the number of individuals who may be unavailable on the eve of a hypothetical deployment due to disease and nonbattle injury (DNBI) hospital admissions.

Methods: a Cohort of Navy personnel enlisting after the Fulg War (April 1991- December 1992) was defined using service history files maintained by Naval Health Research Center (NHRC) in San Diego. The length of each service member's time in the Navy was determined from the service history files, and hospital admissions records for this cohort extracted from medical history files maintained by NHRC. Rates of DNBI incidence and mean lengths of treatment were computed for the overall cohort, and for men and women service members separately.

Results: The overall rate of hospitalization for the Navy cohort examined was 0.304 admissions per 1000 strength per day. The mean length of treatment was 5.32 days. Multiplying the admission rate times the mean length of treatment yields a 'medically infective' rate' of 1.62 individuals per 1000 strength per day. A substantial gender difference in hospitalization incidence did exist, due largely to female admissions for pregnancy-related conditions.

Conclusions: Determination of the levels of training and cross-training of personnel on advanced technologies critical to mission success should take into consideration that two people per 1000 strength may be medically ineffective on any given day.

14. SUBJECT TERMS

disease and nonbattle injury (DNBI); hospital admissions; hospitalizations; men and women service members

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